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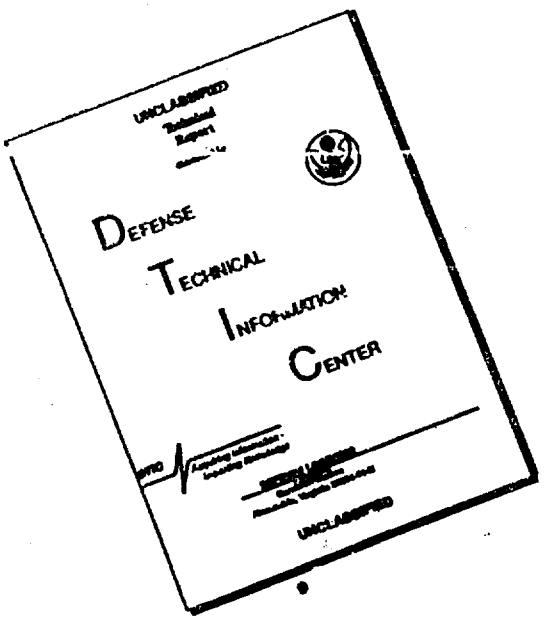

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by

V. S. Antonov

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13. ABSTRACT

Military uniforms, shoes, and other articles were disinfected with ethylene oxide in sacs made of polyethylene film. No changes in the external appearance of the articles were noted after exposure to the 4-10 hours at a dose of 20-30 g/kg. "Experimental" and "control" shoes were indistinguishable after one and a half years of wear. Shrinkage, durability, and stretching were tested in materials used for military uniforms. No adverse effects were detected even after 2-month storage following 10-fold treatment with ethylene oxide.

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THE EFFECT OF DISINFECTION WITH ETHYLENE OXIDE ON PHYSICOMECHANICAL PROPERTIES OF CERTAIN OBJECTS

It is known that during disinfection by the steam method, undesirable changes occur in the quality of objects. Thus, under the influence of saturated steam the external form and color of fabrics change, brightness is lost, smooth surface becomes rough, shrinkage of fabrics is observed, and their durability is decreased (Levashov, 1900; Morberg, 1902; Patsanovskiy, 1902; Mendizo, 1903; Aleksandrov, 1911; Okunevskiy and Glibin, 1932; Boldyrev and Okunevskiy, 1934). During treatment of fabrics in paraformal chambers their durability is also significantly reduced (Mikhel'son, 1938). Decontamination with disinfectant solutions is usually accompanied by considerable shrinkage of fabrics. For example, finely woven fabrics during wetting shrink up to 7%, coarsely woven - up to 6% along warp and up to 14% along the weft, a linen border - up to 12%, etc. (Filatova, 1960).

Nikitin et al (1963) have shown that during disinfection of objects of synthetic materials, various methods (steam, exhaust, paraformalin, boiling, soaking in disinfectant solutions) change one or another of the properties of the treated substances (weight, color, transparency, odors, stiffness, elasticity, durability, relative length, microstructure etc.).

According to the reports of a series of authors (Neumann et al, 1955; Jerundy et al, 1957; Lehmann, 1962; Subbotin and Prishchep, 1963; Banhalmi and Takas, 1965 etc.), disinfection with ethylene oxide is not accompanied by a

change in the quality of the majority of treated samples. However, this deduction, at least in relation to samples of clothing and shoes, is speculative.

Disinfection which we carried out with ethylene oxide of military equipment, shoes, bed parts, documents, and certain other articles with the chamber-less method in sacks of polyethylene film (at a dose of preparation of 20-30 g per kg of article at exposure of 4-10 hours) did not cause any change in the external form of the treated articles. But for more objective evaluation of the properties of the articles after disinfection we carried out tests in the wearing of shoes, and for six types of fabrics, shrinkage, durability, and relative elongation were determined.

Twenty pairs of new leather hospital slippers after 5-fold treatment with ethylene oxide (30 g/kg with exposures of 24 hours and a one day interval between treatments) and twenty pairs of untreated, "control" slippers were given out in the medical department for experimental wearing. After 1 and 1½ years the "experimental" group of slippers was not distinguishable from the "control" in either external appearance, or in the wear of the soles, or in the condition of the seams.

Thus, the test wearing of slippers indicated that the durability of the shoes did not change as a result of treatment with ethylene oxide.

The study of shrinkage, durability and relative elongation of fabrics was carried out according to the All-Union State Standards 3813-47 (1964). Samples of fabrics used for sewing military uniforms underwent examination: Cloth overcoats semi-rough article 4414, bleached sheeting article 52, diagonal breeches article 706, canvas tents article 565, knit variegated suits article 688, satin knit article 559.

In order to determine shrinkage, 8 rectangular samples were cut from each tested fabric, which were numbered, and the direction of the warp and weft marked with a pencil. In the corners of a piece of fabric and in the middle of each side labels were embroidered with colored threads. After maintaining the fabrics for a period of days at constant temperature (20± 5°) and relative humidity (65± 5%) tests

were carried out on each piece (3 along the warp and 3 along the weft) between the colored labels. On the basis of 3 measurements an arithmetic mean was calculated. After this, the fabrics in place of the complete military uniform were treated with gaseous ethylene oxide for 48 hours (at a dose of preparation of 30g/kg). At the end of the exposure, the fabrics were aired for three hours, maintained for days under the same conditions as before treatment with ethylene oxide, then again measured. Repeated measurements were carried out on two samples after 1- 5- and 10- fold treatments. These two samples were subjected to ten-fold action of ethylene oxide, but measurements were not carried out immediately, but after two months of storage in a warehouse at room temperature and relative humidity of 50-70%.

Shrinkage of Fabrics After Treatment with Ethylene Oxide (In %)

Table 1

Type of Fabric	Treatment							
	Single		5-Fold		10-Fold		2 months after 10-fold treatment	
	o	y	o	y	o	y	o	y
Bleached sheeting	0,1	0,4	0,5	0,4	0,3	0,5	0,3	0,4
Cloth great coat	0,3	0,1	0,3	0	0,3	0,5	0,4	0,3
Diagonal breeches	0,4	0,3	0	0,5	0,5	0,5	0,4	0,4
Canvas Tent	0,2	0,5	0,2	0,2	0,5	0,5	0,1	0,3
Knit Suit	0,3	0,5	0,4	0,4	0,3	0,2	0,2	0,2
Satin knit	0,3	0,3	0,4	0,5	0,4	0,5	0,4	0,5

o=Warp y=Weft

The average shrinkage for each of the two samples of fabrics (the ratio of differences in dimensions obtained when measuring fabrics before and after treatment with ethylene oxide, to measurements before treatments) are presented in Table 1. As can be seen from the data presented, there was practically no shrinkage of fabrics after treatment with ethylene oxide (along the weft and along the warp it did not exceed 0.5%). No regularities were noted in changes in shrinkage of fabrics dependent on

the length of ethylene oxide treatment; this was also confirmed by statistical data (in all experiments $P > 0.05$).

The resistance of fabrics to tearing was determined on a tearing machine PT-250. For each type of fabric, durability of 10 strips was tested along the warp and along the weft. Strips of fabric were taken 50mm in width and 100mm in length for overcoat cloth and 200mm for the remaining fabrics. According to the results of tearing of 10 strips, an arithmetic mean was found which served as a control for comparison with the durability of the same fabrics after undergoing ethylene oxide treatment. After disinfection the fabrics were tested for tearing, having first been aired and stored for days under the same conditions as before determination of shrinkage. Resistance to tearing was determined after 1-, 5-, and 10-fold treatment of fabrics with ethylene oxide, and also two months after 10-fold treatment.

As can be seen in Table 2, after treatment of fabrics with ethylene oxide both an increase and a decrease in durability occurred in comparison with corresponding controls. However, these differences were statistically unreliable ($P > 0.05$); and are apparently explained not by the effect of ethylene oxide but by the nonstandard durability of individual fabric threads. No regularities in changes of durability of fabrics were noted with an increase in the length of treatment.

Stretching of fabrics were determined at the same time as testing of durability on tearing machine PT-250 by the stretching of strips of fabric until the moment of tearing. The absolute stretching of fabrics was measured with a precision up to 1mm and according to the results an arithmetic mean for stretching of 10 strips was determined. Then for each type of material the relative stretching before and after ethylene oxide treatment was determined.

Table 2

Change in Durability (in kg) of Fabrics After Disinfection With Ethylene Oxide (M ± m)

Type of Fabric	Состояние ткани	Control	Treatment			
			Single	5-Fold	10-Fold	2 months after 10-fold treatment
Bleached sheeting	О	53,2±0,67	55,5±0,23	52,0±0,23	52,5±0,27	52,0±0,23
	t	—	2,0	1,7	1,0	1,7
	У	46,3±1,37	45,3±1,21	45,6±0,24	44,7±0,95	47,0±1,4
	t	—	0,6	0,5	1,2	0,36
Cloth great coat	О	48,3±0,25	47,6±0,4	48,9±0,43	48,5±0,37	47,0±0,51
	t	—	1,5	1,2	0,5	2,3
	У	46,7±0,77	47,3±0,84	47,0±0,42	46,6±0,7	46,5±0,75
	t	—	0,5	0,37	0,09	0,19
Diagonal breeches	О	94,0±0,24	94,3±1,6	93,4±1,0	94,1±0,81	92,0±0,81
	t	—	0,2	0,6	0,12	1,4
	У	93,1±0,68	92,8±1,06	91,4±1,7	93,5±1,9	93,3±1,3
	t	—	0,24	0,9	0,2	0,14
Canvas Tent	О	86,0±1,3	85,2±1,9	85,6±0,85	84,3±0,85	85,3±0,7
	t	—	0.35	0,25	1,1	0,5
	У	73,0±1,5	74,3±1,8	77,5±2,1	70,0±1,8	74,1±1,1
	t	—	0,5	1,8	1,2	0,6
Knit suit	О	89,5±1,5	89,6±1,3	87,5±1,0	90,0±0,8	87,7±1,4
	t	—	0,06	1,1	0,3	0,8
	У	76,0±0,84	74,4±1,5	75,8±1,7	78,9±1,7	75,3±1,6
	t	—	0,9	0,1	1,5	0,4
Satin knit	О	56,4±0,57	54,1±0,81	55,7±2,6	57,0±0,9	56,8±1,6
	t	—	2,3	0,26	0,56	0,23
	У	90,5±1,3.	90,8±2,02	89,4±1,5	91,3±0,9	89,1±0,9
	t	—	0,2	0,55	0,65	1,1

О=Warp У=Weft
В=Structural Part of Fabric

Note. Criterion t here and in Table 3 was calculated for differences in average experimental and corresponding control samples.

The method of treatment with ethylene oxide was the same as that used when determining shrinkage of fabrics.

The results of the research, presented in Table 3, indicate that the amount of stretching of fabrics after treatment was virtually unchanged in comparison with the control ($P > 0.05$).

An increase in the number of treatments, as in previous research on resistance to tearing, did not produce regular displacements in the stretching indices.

Thus, 10-fold treatment of fabrics with ethylene oxide was not accompanied by shrinkage and did not lead to a change in their durability.

Table 3

Change in Amount of Relative Stretching of Fabrics (in %) After Disinfection with Ethylene Oxide (M ± m)

Type of Fabric	Вид	Control	Treatment			
			Single	5-Fold	10-Fold	2 months after 10-fold treatment
Bleached sheeting	О	15,1±0,11	14,8±0,14	15,2±0,15	15,3±0,15	14,2±0,15
	t	—	1,7	0,6	1,1	1,5
	У	49,9±1,1	50,2±0,36	50,3±0,33	49,5±0,28	50,8±0,45
	t	—	0,2	0,66	0,13	0,56
Cloth great coat	О	32,6±0,36	32,6±1,07	31,7±0,21	32,0±0,15	32,2±0,36
	t	—	0	1,3	1,0	0,8
	У	47,0±0,7	46,6±0,56	46,1±0,3	47,6±1,6	46,1±0,3
	t	—	0,5	1,2	0,4	1,2
Diagonal breeches	О	31,3±0,66	32,2±0,49	30,8±0,47	30,9±0,21	30,3±0,18
	t	—	1,0	1,8	0,64	1,5
	У	21,5±0,43	21,6±0,58	21,4±0,21	20,6±0,33	21,6±0,47
	t	—	1,6	0,09	1,0	0,8
Canvas Tent	О	26,3±0,48	26,8±0,39	25,2±0,21	25,5±1,7	24,8±0,41
	t	—	0,8	0,2	0,5	0,9
	У	42,6±0,59	42,0±0,48	39,9±1,7	41,7±0,26	40,0±1,7
	t	—	0,7	1,5	1,4	1,4
Knit suit	О	39,8±1,7	40,4±0,8	38,9±0,27	40,8±0,0	39,0±0,41
	t	—	0,8	0,5	0,59	0,5
	У	23,5±0,33	22,8±0,4	22,0±0,29	22,8±0,26	23,0±0,4
	t	—	1,4	1,6	0,8	1,0
Satin knit	О	8,8±0,26	8,4±0,21	8,2±0,15	9,0±0,21	9,4±0,21
	t	—	1,2	0,6	0,6	0,5
	У	54,6±1,7	55,4±0,39	53,2±0,7	53,9±0,77	54,3±1,7
	t	—	0,46	0,8	0,4	1,25

В=Structural part of Fabric О=Warp У=Weft

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The Effect of Disinfection With Ethylene Oxide on Physico-Mechanical Properties of Certain Objects

V. S. Antonov

Military uniform, shoes, bedding, documents and some other objects were disinfected with ethylene oxide in sacs made of polyethylene film. No changes were noted in the external appearance of the disinfected objects after exposure of 4 to 10 hours, the dose of the preparation being 20-30 g/kg.

Comparison of wearing out of the treated and control shoes demonstrated that in one and a half year wear the

"experimental" and "control" shoes failed to differ from each other.

Shrinking, durability and relative elongation of materials used for military uniforms was checked after a single, 5-time and 10-time disinfection with ethylene oxide (exposure - 48 hours; the dose of the preparation - 30 g/kg), as well as after two-month storage following 10-time treatment.

As demonstrated, 10-time treatment of materials with ethylene oxide was not accompanied by any shrinking or changes of their durability.